



# 5<sup>th</sup> Annual Botany-Zoology Postgraduate Symposium

14 April 2016



**Programme and Abstracts**



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# WELCOME

Dear friends and colleagues,

It is with great pleasure we welcome you all to the Fifth Botany-Zoology Postgraduate Research Symposium in Trinity College Dublin. Following on from successful previous Symposia the Departments of Botany and Zoology have come together again to present and discuss the wide variety of postgraduate research taking place within the School of Natural Sciences. This symposium is an important medium in which postgraduates are encouraged to share their research, ideas and techniques, as well as an opportunity to gain invaluable presentation experience.

The ethos of the symposium is to provide each postgraduate student with a presentation platform that is open to constructive analysis from the audience. Therefore, for each presentation, each audience member is invited and encouraged to fill out feedback forms which will aid each student in the development of their presentation skills. Guidelines for completion of evaluation forms can be found in the end of this booklet.

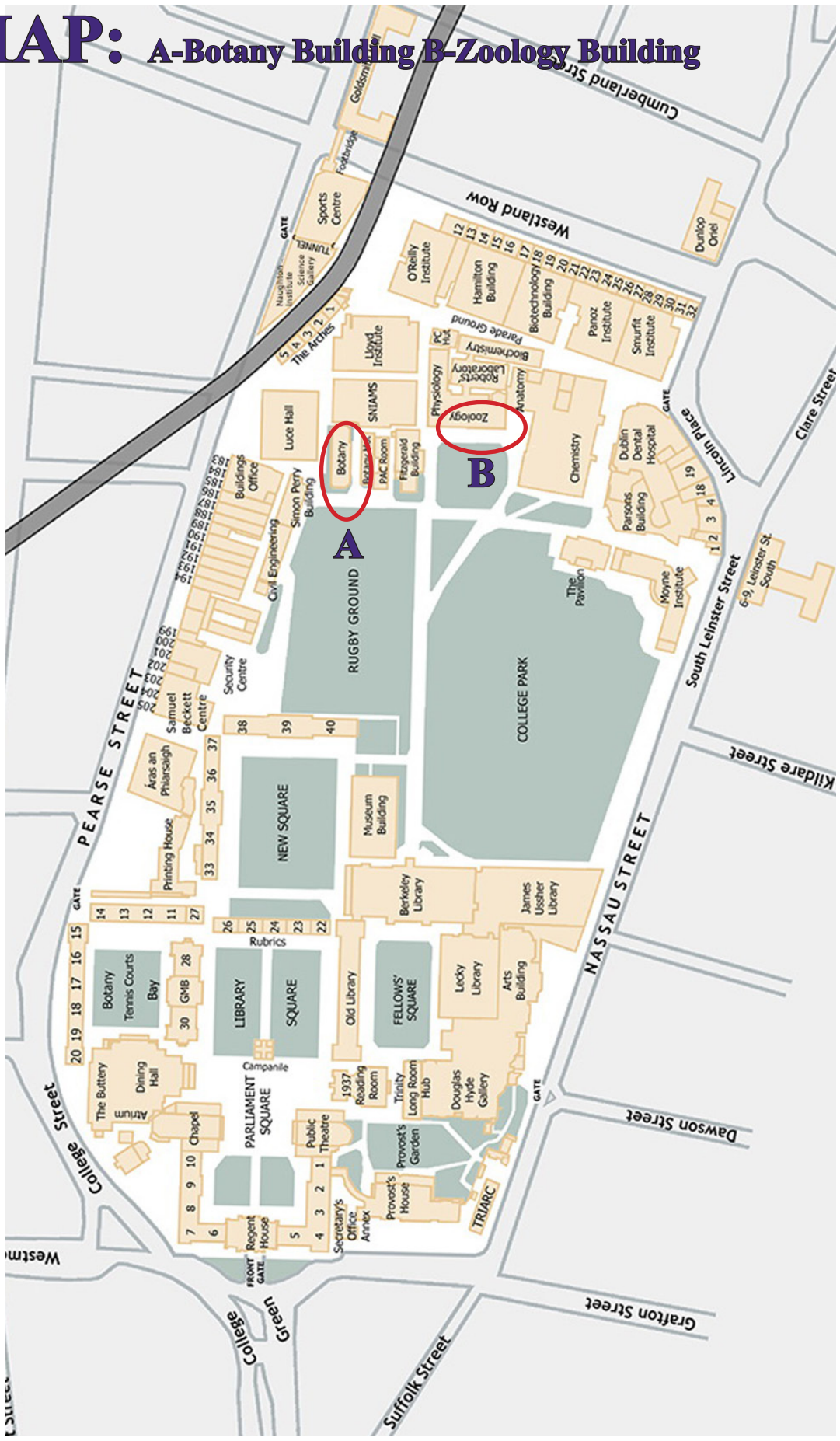
We would like to express our gratitude to Dr. Nina Alpey and Dr. Rob Thomas for kindly offering up their time to adjudicate the symposium. Furthermore, we would like to thank them in advance for the plenary talks they have prepared. We would also like to thank the staff of the Department of Botany and Zoology, especially Prof. Andrew Jackson, Martyn Linnie, Fiona Moloney and Aisling O'Mahony for their assistance in the planning and organising of this Symposium.

We sincerely hope you enjoy this Symposium and find it a stimulating and interesting event.

The Organising Committee

Darren O'Connell, Dermott McMorrough, Sukontip Sirimongkol, Anindita Lahiri

# MAP: A-Botany Building B-Zoology Building



SCHEDULE

<b>Time</b>	<b>Speaker</b>	<b>Venue</b>
9.15-10.15	Invited speaker - Nina Alphey	Botany Lecture Theatre
<b>10.15-10.45</b>	<b>Coffee Break</b>	<b>Botany Library</b>
10.45-11.00	Darren O'Connell	Botany Lecture Theatre
11.00-11.15	Sukontip Sirimongkol	Botany Lecture Theatre
11.15-11.30	Dermott McMorrough	Botany Lecture Theatre
11.30-11.45	Anindita Lahiri	Botany Lecture Theatre
11.45-12.00	Maureen Williams	Botany Lecture Theatre
12.00-12.15	Aoife Delaney	Botany Lecture Theatre
12.15-12.30	Qiang Yang (Marvin)	Botany Lecture Theatre
12.30-12.45	Alwynne McGeever	Botany Lecture Theatre
12.45-13.00	Dongwei Zhao	Botany Lecture Theatre
<b>13.00-14.00</b>	<b>Lunch</b>	<b>Botany Library</b>
14.00-15.00	Invited speaker - Rob Thomas	Botany Lecture Theatre
<b>15.00-15.30</b>	<b>Coffee Break</b>	<b>Botany Library</b>
15.30-15.45	Conor Owens	Botany Lecture Theatre
15.45-16.00	Aoibheann Gaughran	Botany Lecture Theatre
16.00-16.15	Michelle McKeon-bennett	Botany Lecture Theatre
16.15-16.30	Alex O' Cinneide	Botany Lecture Theatre
16.30-16.45	Anne Dubéarnès	Botany Lecture Theatre
16.45-17.00	Eoin Mac Réamoinn	Botany Lecture Theatre

## GUEST SPEAKER

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### **Dr. Nina Alphey**

**Title:** *Modelling genetic control of insect populations*

Nina has an MA from the University of Cambridge (mathematics) and, after many years, a DPhil from Oxford (mathematical biology). She lives behind a keyboard at the University of Oxford, Imperial College London and The Pirbright Institute, where she uses mathematical models to analyse genetics-based methods to control pest populations. Unusually for a biologist, Nina is a Fellow of the Institute of Chartered Accountants in England and Wales, which influences her work.



Research interests: Pest insects do enormous damage to human health (transmitting diseases such as dengue fever) and to agriculture (through damaging crops or livestock). Nina's interdisciplinary research programme explores ecological and genetic aspects of novel methods to control insect populations. She has focussed primarily on transgenic variants of the sterile insect technique, an area-wide method of biological pest control that reduces pest populations by releasing mass-reared sterile insects which compete for mates with wild insects. Mathematical modelling predicts that a variant with female-specific lethality could also slow or reverse the spread of resistance to other control methods.

GUEST SPEAKER

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**Dr. Rob Thomas**

**Title:** *Animal behaviour in changing environments*



Research interests: My research group studies animal behaviour in changing environments. The environmental changes that we study range from long-term climate changes, through seasonal and daily changes, to the sudden appearance of a potential predator or an unfamiliar type of food. In my talk I will focus on the effects of climate on individuals, populations and ecological processes - particularly how such effects may be mediated by the behaviour of individual animals. My current work in this field focuses on several major study systems that use migratory songbirds and seabirds as sensitive bio-indicators of climate-driven changes in trophic relationships. I will examine how behavioural studies can help us to understand the contrasting fortunes of different species of migratory birds, to predict future climate impacts, and potentially to help conserve vulnerable populations in the face of future climate change.

## STUDENT SPEAKERS

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### **Darren O'Connell**

**Supervisors:** Nicola Marples & David Kelly

**Title:** *Ecological character displacement as a driver of diversification*

Since Darwin, competition has been recognised as an important factor driving diversification. Competition is energetically expensive and unstable, so direct competition is rarely observed. One way in which species can avoid competition is ecological character displacement. This is where differences between similar species are accentuated when they co-occur but are lost or minimised when they do not overlap.

We suspect this process may have occurred in our study system of south-east Sulawesi, Indonesia. Two closely related and similarly sized species of kingfisher occur in this region, one resident and one migratory. On the Sulawesi mainland and larger (continental) islands they spatially segregate by habitat and resource partitioning. On the smaller islands of the Wakatobi Archipelago there is less habitat diversity and we do not see evidence of either habitat or resource partitioning. We do see a shift in morphology of one of the competing species, the resident Collared Kingfisher (*Todiramphus chloris*). The Wakatobi population is larger (wing and bill) than mainland populations. The change in habitat structure on the Wakatobi Archipelago bringing these species into closer contact may have promoted this divergence in morphology to alleviate potential competition.

Preliminary genetic work shows divergence between Collared Kingfisher populations of the Wakatobi and Sulawesi mainland, indicating the taxonomy of these populations requires further assessment.



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### **Sukontip Sirimongkol**

**Supervisor:** John Parnell

**Title:** *Morphological characters of Henckelia Spreng (Gesneriaceae)*

The genus *Henckelia* is one of the most complicated genera in the family Gesneriaceae. Recent molecular phylogenetic studies on *Chirita* and *Henckelia* are presented. These have separated *Chirita* from other genera such as *Henckelia*, *Damrongia*, *Microchirita*, *Liebigia* and *Primulina*. Some members *Henckelia* have been moved to other genera including *Codonoboea*, *Didissandra*, *Didymocarpus*, *Lindernia* and *Loxocarpus* resulting in a reduction in the number of *Henckelia* species to 57. Defining morphological characters for *Henckelia* allowing separation from these other genera are as yet unclear but will be derived from materials collected on fieldwork. In addition, for these morphological studies, specimens lent from Aarhus University Herbarium (AAU), University of Aberdeen (ABD), The Natural History Museum (BM), The Forest Herbarium (BKF), Bangkok Herbarium (BK), Royal Botanic Garden Edinburgh (E), Royal Botanic Gardens (K), Kunming Institute of Botany (KUN), The National Herbarium Nederland (L), Singapore Botanic Gardens (SING) will be used. The final thesis will therefore be in part molecular but with palynological, ecological, morphological and biogeographic data. This will allow for a revision of *Henckelia* in Thailand and Indo-China including Myanmar and Southern China.



## STUDENT SPEAKERS

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### **Dermott McMorrough**

**Supervisor:** Andrew Jackson

**Title:** *Now you see me: Examining the variation in time perception*



Sight is one of our most valuable senses: constantly feeding us information about our environment, allowing us to evaluate potential mates, and perhaps most importantly: enabling us to find food. In the animal kingdom, a number of strategies are deployed as individuals and groups go about finding the food necessary for moving, growing, and ultimately passing on ones genes.

The way in which animals and humans acquire, process, and act upon visual information is a highly evolved, intricate process played out over minuscule time scales. In the time it takes for a predator to realise that its prey is about to change direction, or for an expert batsman to notice the spin on an approaching baseball, it is often too late to act. Our knowledge of temporal variation in this key trait lag in comparison with our understanding of spatial acuity.

Using a combination of simulation and psychometric techniques, I aim to tease apart the relationship between information acquisition over discreet temporal scales and the evolutionary consequences for both animal and human systems.

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### **Anindita Lahiri**

**Supervisor:** Trevor Hodkinson, Gerry Douglas, Brian Murphy & Colin Kelleher

**Title:** *Characterizing candidate disease resistance loci in ash (*Fraxinus*) and an assessment of ash fungal endophyte strain variation in Ireland*



Ash is very useful and abundant tree found throughout Europe, which is now threatened considerably because of a disease called ash dieback. It is caused by a fungal pathogen known as *Hymenoscyphus fraxineus* Baral. It can damage plants irrespective of their age group but young plants are more susceptible to the disease. Ash dieback starts from the midrib of the leaves and travels through the midrib to the stem part of the plant where the fungal mycelia blocks the xylem and phloem vessels and the plant dies because of lack of water and nutrients. This project is currently undertaking a comprehensive study of the leaf fungal endophytes

of healthy plants to characterize their microbiome. We have cultured endophytes in a malt extract agar media and isolated them on the same media by sub-culturing. We are currently amplifying nuclear ribosomal bar coding DNA regions and sequencing them to identify the fungal isolates. We will then test the biocontrol potential of some of these against the disease pathogen.

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## STUDENT SPEAKERS

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### **Maureen Williams**

**Supervisor:** Ian Donohue & Celia Holland

**Title:** *Does parasitism interact with warming to modify energy flow in ecosystems?*

Gammarid amphipods are key components of aquatic ecosystems around the globe, acting as important detritivores and frequently dominating benthic assemblages in both rivers and lakes. Their ability to process detritus and return nutrients to the ecosystem may, however, be undermined by infection with behaviour-modifying acanthocephalan parasites. Moreover, as gammarids are ectothermic, the impact of parasitic infection could also vary with temperature. We explore whether parasitism and warming interact to modify energy flow in ecosystems by comparing individual energy budgets for *Gammarus duebeni* that were infected with the common acanthocephalan parasite *Polymorphus minutus*, with those of uninfected individuals of similar size across a broad range of temperatures.



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### **Aoife Delaney**

**Supervisor:** Jane Stout

**Title:** *Do principals of cross congruence apply in a naturally disturbed habitat?*

Cross congruence is a measure of the degree to which diversity (number or composition of species) of different taxa follow broadly similar patterns in response to environmental conditions. In situations where cross congruence is strong, measuring the diversity of a single taxon can provide information regarding overall diversity, and this has led to the development of indicator taxa. Indicator taxa may be used to indicate general patterns of biological diversity or environmental conditions, often with the inference that where the environmental conditions are favourable for one taxon, other target taxa will benefit. The use of indicator taxa has obvious economic appeal, but cross congruence has been shown to vary greatly in different studies. Habitat heterogeneity and environmental stress can reduce the correlation of diversity among different taxonomic groups.



Within the EU, states which have signed up to the Habitats Directive (Council Directive 92/43/EEC) monitor the condition of habitats of conservation concern (Annex I habitats) using standard methods and report their results to the European Commission. Indicator species are used as part of this habitat assessment. Dune slacks, an EU Annex I habitat, are temporary ponds in sand dunes which can persist for long periods, many having been formed as part of the initial dune-building phase. Despite being stable physical features, they experience both environmental stress (annual flooding and desiccation) and temporal habitat heterogeneity, and this raises questions: do principals of cross-congruence apply here, and are indicator species effective? This study compared patterns of diversity among three different taxonomic groups, to test whether cross congruence was observed. Communities of plants, snails and water beetles in twenty-four dune slacks in Ireland were compared using diversity indices and ordination techniques. Dune slacks were assessed on the basis of the indicator species used in reporting to the European Commission, and the biological assemblages of sites which passed and failed the assessment were compared. The results of this research will help to evaluate current monitoring techniques which are in use throughout the EU and guide monitoring approaches for dune slacks in Ireland.

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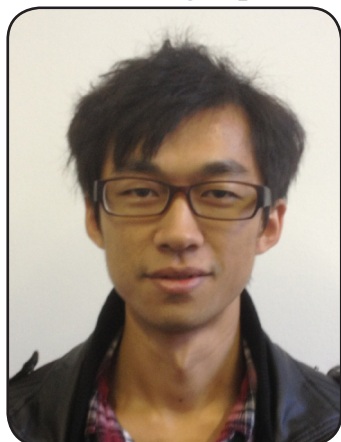
## STUDENT SPEAKERS

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### **Qiang Yang (Marvin)**

**Supervisor:** Ian Donahue & Andrew Jackson

**Title:** *Stronger perturbations increase the complexity of ecological stability*



The stability of ecosystems determines the sustainability of the biological resource and services that nature offers us, and an understanding of mechanisms and drivers of ecological stability has vast implications for the sustainability and management of natural resources as well as the protection and restoration of ecosystems. Much effort has been contributed to understanding the factor that determines the stability of biological communities. A challenging aspect of stability is its many components, including asymptotic stability, resilience, resistance, robustness, persistence, variability and so on, but most of the previous research failed to analyse ecological stability from an comprehensive angle and we know remarkably little about the mechanisms underpinning relationships among components of stability. Therefore, focus on single stability elements may cause an underestimate of the “real stability” of ecosystems. Here in our research, by simulating the dynamics of 13 four-species food webs following perturbations varying in strength, we show that stronger perturbations decouple the relationship between stability components, i.e. that the efficacy of the single stability element in representing the general character of ecological stability becomes lower under strong perturbations. It is therefore necessary to investigate ecosystem stability from multiple angles, especially under strong disturbance frequently shown in real nature. The decoupling effect of perturbations on the multidimensionality of ecological stability is universal across most of the 14 food-web motifs in our research, implying a similar pattern in more complex large ecological networks.

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### **Alewynne McGeever**

**Supervisor:** Fraser Mitchell

**Title:** *Population dynamics of Pinus and Ulmus in Europe during the Holocene.*



This work investigates and compares the population dynamics of *Pinus* and *Ulmus* in Europe, during the Holocene, at varying temporal and spatial scales, by using recently developed and novel modelling methods.

The first component characterises the European-wide post glacial rise and mid-Holocene decline experienced by both genera. Pollen data was extracted from 330 sites on the European Pollen Database (EPD). The depth of rise and decline events for each genus in each site core was defined by applying a spline curve, to remove stochastic noise from the pollen data, and identifying the range of depths along which the pollen values increased or decreased. The R package Bchron was used to calibrate radiocarbon dates and produce an age-depth model for each site, using stochastic linear interpolation and Monte Carlo methods. The age-depth model data was applied to the event depth range to produce a probability distribution of when the rise and decline events occurred.

The second component characterises *Ulmus* and *Pinus* when they were abundant on the European landscape. Depth and magnitude data of maximum pollen values for both genera were gathered from the EPD. The age-depth models were used to determine the age of the maximum pollen value depths.

These data were then plotted on maps and empirical Bayesian kriging was used to interpolate the spatial and temporal dynamics of these population events in the two tree genera. This work, therefore, presents novel techniques to quantifying tree population dynamics, and also provides insight into the specific dynamics of two major tree genera in Europe.

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## STUDENT SPEAKERS

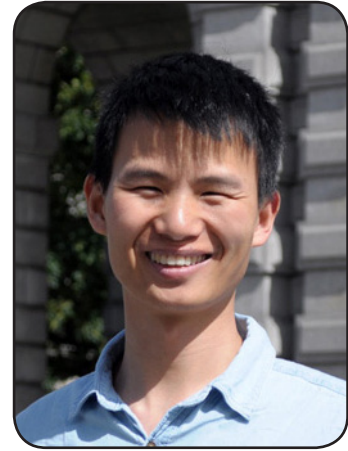
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### **Dongwei Zhao**

**Supervisor:** John Parnell & Trevor Hodkinson

**Title:** *Phylogenetics of Camellia (Theaceae) in Indochinese Peninsula*

Tea, camellias and oil camellias from the genus *Camellia* L. (Theaceae) are commercially highly important. About one third of all known *Camellia* species occur in the Indochinese Peninsula, of which half are endemic. Many new names of *Camellia* are still being described from this area, which may suggest that it was previously under-collected. Almost no work, however, has focused on the phylogenetics of *Camellia* in this area. This project aims to address these issues using morphological and molecular approaches. Morphological studies, consisting of a comparison and description of various macro-characters of specimens and palynological analyses, will be undertaken to clarify the boundaries of species in this notoriously variable genus. DNA markers derived from nuclear and chloroplast genomes will be selected to generate molecular sequence data, which will be used to reconstruct a robust phylogenetic tree. A new classification of this genus could then be proposed based on both morphological and molecular data. Species that have potential to supply new traits to the cultivars of tea, camellias and oil camellias could also be identified.



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### **Conor Owens**

**Supervisor:** Fraser Mitchell & Jane Stout

**Title:** *Biodiversity in willow evapotranspiration systems for wastewater treatment*

Constructed wetlands are increasingly seen in Ireland and abroad as a solution to the on-site treatment of wastewater from domestic and other sources in rural areas. They are likely permanent features in our landscape that will proliferate into the future. Willow evapotranspiration systems are a subtype suitable for application in areas with low permeability subsoils. These systems are often promoted as having a beneficial role with respect to biodiversity but this has not been rigorously evaluated. This project aims to assess the plant and invertebrate biodiversity of these systems and the contribution they make to the biodiversity of the wider landscape. The factors driving biodiversity in these systems are being investigated and thus this project will provide management recommendations to maximise this biodiversity. This project involves cross discipline collaboration, drawing on expertise from both the TCD School of Natural Sciences and the TCD School of Engineering.



## STUDENT SPEAKERS

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### **Aoibheann Gaughran**

**Supervisor:** Nicola Marples

**Title:** *How population density influences social mammal ecology: A case study of the European badger.*



The local density of a population of social mammals can affect many aspects of its ecology including social structure, mating systems, dispersal behavior, territorial behavior and the dynamics of disease. Scientists and policy-makers need a comprehensive understanding of the local population density as this may dictate the most effective management strategy. The European badger provides a particularly good species to investigate the effects of population density on other density parameters because its density varies by orders of magnitude across its wide geographic range. Further, it acts as a wildlife reservoir for bovine tuberculosis in the UK and Ireland, where it is subject to control operations. Currently, a haphazard classification of local population densities hampers a clear understanding of the badger's ecology, leading to inappropriate management systems. We have conducted a meta-analysis to investigate the relationships between social group size, territory size, and group density and population density in badgers. We demonstrate that population density fundamentally alters badger ecology, affecting the interactions both within and between social groups. We also propose a classification system for densities of the European badger which highlight important ecological differences between populations across the density spectrum. Our findings provide a more cohesive picture of the species' ecology across its range, facilitating appropriate targeting of disease management and conservation regimes.

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### **Michelle McKeon-Bennett**

**Supervisor:** Trevor Hodkinson

**Title:** *Characterisation of endophytic microbes within *Sphagnum magellanicum* from Clara Bog, County Offaly, Ireland: Implications for enclosed environment hydroponic systems in Space.*



This work investigates potential mutualistic relationships between endophytic microbes and species of native *Sphagnum* moss sampled from Clara Bog, County Offaly, Ireland. The application of the ion-exchange ability of *Sphagnum* moss to water remediation and recourse recovery within an enclosed hydroponic system has been investigated by the author at NASA's Space Life Science Laboratory, Kennedy Space Centre, Florida. While this research indicated that *Sphagnum* could be utilized in this manner, it resulted in yet more questions, specifically in relation to microbial interactions and growth mechanisms within the *Sphagnum*:plant test bed.

It is postulated that endophytic microbes growing mutualistically within *S. magellanicum* may be responsible for (a) anti-algae and anti-microbe effects within the hydroponic system and (b) increased nutraceutical content within the associated salad crop. Microbial DNA isolated from 100ug samples of *S. magellanicum*, was extracted and used to identify microbial endophytes using standard barcoding primers. Genetic fingerprinting is being utilised to type the endophytes. Isolation and culturing protocols from *Sphagnum* plants have been developed and applied for the characterisation of microbial species during hydroponic systems using *S. magellanicum* as a growth medium. Further investigation of mutualism between identified endophytes and a cultivar of *Lactuca sativa* known as 'Lollo Rosso' is ongoing.

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## STUDENT SPEAKERS

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### Alex O’Cinneide

**Supervisor:** Anna Davies & Martin Sokol

**Title:** *Incentives and efficacy: An evaluation of renewable energy policies in Europe 1995-2015*

Over the last twenty years the EU and its individual countries have been engaged in implementing policies to increase the use of renewable energy (RE) as a generation source. Motivations for this support of RE generation include, but are not limited to, concerns over climate change and pollution, national security risks associated with fossil fuels, and a wish to increase the competitive position of RE in markets which have been traditionally dominated by carbon based power. The issue of climate change and renewable power’s role in addressing this complex challenge has, in particular, been brought into sharper focus following agreement on emissions pledges from all the EU countries, and a new target of keeping global warming below 1.5C in December 2015 in Paris at COP 21; targets which will require a material response by policy makers throughout the EU. An understanding of what policies have been most effective in increasing RE is therefore critically important in designing new schemes, a comprehensive analysis of which has not been completed to date. I am therefore conducting a comparative analysis of the effectiveness of RE policies in encouraging RE generation (solar and wind, which given their advantages in cost and deployment have been the dominate focus of policy) across the EU from 1995 to 2015, with a primary focus on four countries of contrasting contexts, Ireland, UK, Italy and Portugal. While several studies have attempted to determine the effectiveness of various policies in various countries, these have been limited in scope and have not attempted to account for the variety of policy design features or individual country, market and key actor characteristics that influence policy strength. Adopting an energy transitions theoretical framework, this research would constitute the first study undertaken to determine how policy has effected the growth of renewables across Europe.



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### Anne Dubéarnès

**Supervisor:** John Parnell & Trevor Hodkinson

**Title:** *Systematics of the genus Embelia Burm.f. (Primulaceae – Myrsinoideae)*

Within the Primulaceae family, the Myrsinoideae form a highly variable tropical group, ranging from climbers and shrubs to trees, and characterised by the presence of dark dots on the leaves and fruits. This subfamily contains over 1300 species, divided into approximately 40 genera. Many of these genera are in need of taxonomic revision, as their limits are poorly defined and sometimes rely on ambiguous characters. Among these genera is *Embelia*, a genus of climbing shrubs distributed mostly in South and South-East Asia, tropical Africa and Madagascar. *Embelia* displays extensive morphological variation - especially regarding the position, shape, size and merosity of the inflorescences and flowers. It is distinguished from other Myrsinoideae only by the climbing habit, and the relationship with morphologically similar genera has not been critically evaluated yet. The last monograph of *Embelia* by Mez (1902), recognised eight subgenera and 92 species, but the total number of species is currently estimated at 150-200, and the subgenera used by Mez must be assessed and refined. My project aims to combine morphological and molecular data in order to test the monophyly of *Embelia* and to provide a taxonomic framework of the subgenera.

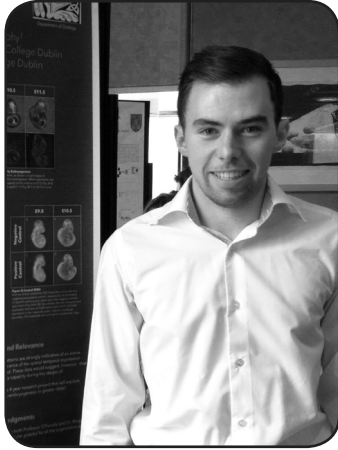


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**Eoin Mac Réamoinn**

**Supervisor:** Cliona O'Farrelly & Paula Murphy

**Title:** *Toll-Like Receptor Gene Expression During Early Murine Embryonic Development.*



Toll-like receptors (TLRs) are renowned for their fundamental roles in immunological surveillance and response initiation. While TLR proteins in invertebrate species, such as *Drosophila*, carry out functions in the immune system and in “building” the body plan in the embryo, such non-immune functions have not been thoroughly investigated in mammals. Although TLR genes have duplicated independently in these lineages, and may therefore have diverged in aspects of their functionality, limited studies have recently reported the expression of TLRs in the developing mammalian embryo (Kaul et al., 2012). We report a systematic study of Tlr gene expression in early to mid-gestational murine embryos using whole-mount RNA in situ hybridization and 3D imaging (using Optical Project Tomography), the combination of which has allowed us to record the precise tissues and stages at which these genes become expressed. We have found that the expression of these receptors is particularly enriched within the central nervous system with many Tlrs displaying complementary expression patterns in developing neural tissues, as is the case with Tlrs -1, -5, -6, and -7 in the neural tube at embryonic day 10.5. These findings are in line with experimental data showing that Tlrs -2, -3, and -4 can influence neural progenitor cell proliferation and self-renewal (as reviewed in Barak et al., 2014). In addition to the expression data we have generated, whole-transcriptome data is being mined to build a comprehensive picture of Tlr activity during embryogenesis and will aid in the building of specific hypotheses for functional testing.



## **Guidelines for Completion of Presentation Evaluation Forms**

Please evaluate anonymously using the following categories to rank presentations:

### **Organisation**

- Structure of presentation (clear, logical, etc.)
- Aims of study (clearly stated and evident throughout the presentation)

### **Scientific Content**

- Background
- Methodology
- Logical progression of scientific ideas

### **Voice**

- Clear, strong, etc.

### **Body Language**

- Eye contact with audience
- Position relative to audience
- Gestures/movement

### **Timing**

- Adherence to time limit (15 minutes: 12 minute presentation; 3 minutes for questions)

### **Audio-Visual Aids**

- Clear, legible text and figures

### **Handling Questions**

- Confidence
- Ability to formulate adequate responses
- Open to suggestions and new ideas



## TCD Botany-Zoology Postgraduate Symposium

### Presentation Evaluation Form

Presenter: \_\_\_\_\_

Category	Excel- lent	Very good	Good	Need Improvement	Comments
Organisation					
Scientific Content					
Voice					
Body Language					
Timing					
Audio-visual Aids					
Handling Questions					

Best aspect of talk:

Aspects requiring improvement:

Other points: